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Spectroscopic Observations of the Eclipse of the Moon, 1878, *August* 12, *made at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal*).

The following observations were made by Mr. Maunder, with the Great Equatoreal and Single Prism Spectroscope:—

The Moon, as viewed in the finder of the Great Equatoreal, appeared to have the eclipsed part completely cut out from it, the shadow being so dense and black that the outline of the Moon's limb could not be traced under it, even in imagination; nor could any features be made out on the eclipsed part, except at the very edge of the shadow. As viewed in the Single Prism Spectroscope, there was by no means the same difference in the amount of apparent brilliancy. The spectrum of the bright part was about three times as bright as that of the part in shadow, and could not be traced much further either way, the bright part being visible from Fraunhofer's cluster B to midway between *h* and H; the eclipsed part from about wave-length 6450 tenth-metres ±, near Band β of the Brewster-Gladstone spectrum, to *h*. The spectrum of the eclipsed part presented a great contrast to its appearance during the total eclipse of 1877, August 23, in the almost total absence of the telluric bands; Band δ, which was so dark and broad on that occasion, being now scarcely visible; and the only other one seen was one just suspected near Band o. The only other evidence of atmospheric absorption was a general absorption beyond D to the red, and beyond G to the violet.

Royal Observatory, Greenwich,
1878, *August* 31.

The Proper Motions of certain Stars in the Greenwich Seven-Year Catalogue for 1864. By A. W. Downing, B.A.

Having occasion lately to refer to the proper motions of stars in the first four hours of right ascension, I was surprised to find that there were still so many of the stars observed by Bradley whose proper motions have not been determined by comparison with accurate modern places; so that astronomers still use, in many cases, the untrustworthy proper motions of the British Association Catalogue.

The present paper is an attempt to partially supply, for stars in the first four hours of right ascension, this deficiency in our knowledge of accurate proper motions. It contains the proper motions of the stars, within the above-mentioned limits of right ascension, which are common to Bradley's Catalogue in Bessel's *Fundamenta Astronomiæ* and the Greenwich Seven-Year Catalogue for 1864, the quantities of proper motion being deduced

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from a comparison of the places given in these catalogues. I have, of course, omitted the Bradley stars in the latter catalogue whose proper motions have been determined by Main or Stone, and I have also omitted those which appear in the new Nine-Year Catalogue for 1872, so that the places of all in my list must depend, at least for some time to come, on the Seven-Year Catalogue for 1864.

The method of computation which I have adopted is that explained by Mr. Main in the 19th volume of the *Memoirs* of this Society, viz., if p_1, p_2, and p_3 be the annual precessions, in R.A. or N.P.D., for any star at equidistant epochs, the mean annual precession $= \frac{1}{6}(p_1 + 4p_2 + p_3)$; and I have applied the necessary corrections to Bessel's precessions as given in the *Fundamenta* to reduce them to precessions deduced from Peters' Constants. Then, as Bessel has given the precessions of each star for the epochs 1755 and 1800, it is easy from the latter to compute the precession for the middle year between 1755 and the mean year of observation of the star given in the Greenwich Catalogue, and from the precession given in the latter catalogue to compute it for the mean year of observation, and thus obtain three precessions at equidistant epochs, and thence, by means of the formula given above, to find the mean annual precession.

In computing the mean annual motions I have been careful to correct the places in the Seven-Year Catalogue for the quantity of proper motion applied to the observed place to reduce it to the mean epoch of the catalogue, but the places in the *Fundamenta* have been used without any correction whatever. Of course it is very easy to correct the resulting proper motions for any correction that may be applied to the *Fundamenta*, as it is simply $-\frac{\Delta\alpha}{109}$ or $-\frac{\Delta\delta}{109}$, where $\Delta\alpha$ and $\Delta\delta$ are the corrections to the R.A. and N.P.D. respectively.

Having found the mean annual precession and mean annual motion, then in all cases

Proper motion = Mean annual motion − Mean annual precession.

As none of the stars whose proper motions are given in this paper are very near the pole, the same method has been used for all.

Unfortunately there are several instances in which a star has been observed by Bradley in one element only, and some in which the place in the *Fundamenta* depends on a single observation. In this latter case I have always marked the resulting proper motion with an asterisk.

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No.	Name of Star.	Approx. R.A. 1864. h	m	Mean Precession in R.A. s	Mean Annual Motion. s	Proper Motion in R.A. s	Mean Precession in N.P.D. ″	Mean Annual Motion. ″	Proper Motion in N.P.D. ″
1	4 Ceti	0	1	+3·0717	+3·0705	−0·001	−20·058	−20·077	−0·02
2	5 Ceti	0	1	3·0715	3·0670	−0·005	20·059	20·058	0·00
3	23 Andromedæ	0	6	3·0894	3·0767	−0·013	20·057	19·919	+0·14
4	7 Ceti	0	8	3·0604	3·0586	−0·002	20·054	19·981	+0·07
5	36 Piscium	0	9	3·0755	3·0716	−0·004	20·050	20·022	+0·03
6	37 Piscium	0	10	3·0804	3·0784	−0·002			
7	38 Piscium, 2nd star	0	10	3·0772	3·0788	+0·002	20·048	20·128	−0·08
8	39 Piscium	0	11	3·0843	3·0998	+0·016	20·047	20·023	+0·02
9	42 Piscium	0	15	3·0873	3·0906	+0·003	20·029	20·037	−0·01
10	9 Ceti	0	16	3·0530	3·0780	+0·025	20·026	20·082	−0·06
11	Bradley 27	0	19	3·1038	3·1016	−0·002*			
12	Bradley 30	0	20	3·0986	3·1053	+0·007*	20·000	20·008	−0·01*
13	46 Piscium	0	21	3·1063	3·1025	−0·004	19·997	19·983	+0·01
14	47 Piscium	0	21	3·1032	3·1110	+0·008	19·996	20·027	−0·03
15	48 Piscium	0	21	3·1005	3·1000	−0·001	19·995	19·982	+0·01
16	49 Piscium	0	24	3·1038	3·0978	−0·006	19·975	19·996	−0·02
17	Bradley 41	0	25	3·1049	3·1026	−0·002	19·970	19·943	+0·03
18	54 Piscium	0	32	3·1344	3·0991	−0·035	19·892	19·518	+0·37
19	55 Piscium	0	33	3·1360	3·1365	+0·001	19·888	19·850	+0·04
20	32 Andromedæ	0	34	3·2138	3·2138	0·000	19·877	19·876	0·00

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21	Bradley 64	0	35	3·2242	3·2209	−0·003*			
22	Bradley 68	0	37	3·2818	3·2761	−0·006			
23	18 Ceti	0	39	3·0194	3·0130	−0·006	19·813	19·593	+0·22
24	57 Piscium	0	39	3·1260	3·1234	−0·003	19·802	19·753	+0·05
25	61 Piscium	0	41	3·1507	3·1589	+0·008	19·785	19·771	+0·01
26	62 Piscium	0	41	3·0955	3·0987	+0·003	19·776	19·765	+0·01
27	64 Piscium	0	42	3·1357	3·1324	−0·003	19·768	19·554	+0·21
28	*i* Piscium	0	43	3·1870	3·1913	+0·004	19·756	19·736	+0·02
29	ϕ^2 Ceti	0	43	3·0225	3·0046	−0·018	19·744	19·504	+0·24
30	66 Piscium	0	47	3·1660	3·1541	−0·002	19·681	19·675	+0·01
31	21 Ceti	0	47	3·0264	3·0262	0·000	19·678	19·618	+0·06
32	ϕ^3 Ceti	0	49	3·0123	3·0086	−0·003	19·646	19·629	+0·02
33	ϕ^4 Ceti	0	52	3·0084	3·0036	−0·005	19·597	19·562	+0·04
34	25 Ceti	0	56	3·0394	3·0287	−0·011	19·515	19·410	+0·11
35	Bradley 112	0	56	3·4823	3·4648	−0·018*			
36	Bradley 114	0	57	3·7376	3·7397	+0·002*			
37	ψ^1 Piscium	0	58	3·1907	3·1938	+0·003	19·473	19·426	+0·05
38	Bradley 122	0	58	3·1907	3·1928	+0·002	19·473	19·426	+0·05
39	27 Ceti	0	59	3·0081	3·0038	−0·004	19·460	19·424	+0·04
40	28 Ceti	0	59	3·0083	3·0077	−0·001	19·450	19·470	−0·02
41	78 Piscium	1	1	3·2710	3·2836	+0·013	19·429	19·381	+0·05
42	ψ^2 Piscium	1	1	+3·1908	+3·1947	+0·004	−19·423	−19·327	+0·10

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No.	Name of Star.	Approx. R.A. 1864. h	m	Mean Precession in R.A. s	Mean Annual Motion. s	Proper Motion in R.A. s	Mean Precession in N.P.D. ″	Mean Annual Motion. ″	Proper Motion in N.P.D. ″
43	30 Ceti	1	1	+3·0071	+3·0159	+0·009	−19·414	−19·409	+0·01
44	29 Ceti	1	1	3·0770	3·0833	+0·006	19·416	18·952	+0·46
45	44 Andromedæ	1	3	3·3709	3·3578	−0·013	19·383	19·320	+0·06
46	32 Cassiopeiæ	1	3	3·7761	3·7743	−0·002	19·385	19·371	+0·01
47	32 Ceti	1	3	3·0099	3·0062	−0·004	19·359	19·299	+0·06
48	45 Andromedæ	1	4	3·3317	3·3287	−0·003	19·361	19·365	0·00*
49	*g* Piscium	1	4	3·2768	3·2748	−0·002	19·359	19·349	+0·01*
50	Bradley 153	1	6	3·2715	3·2737	+0·002			
51	35 Ceti	1	6	3·0803	3·0752	−0·005			
52	36 Ceti	1	6	3·0212	3·0187	−0·003	19·298	19·277	+0·02
53	*φ* Piscium	1	6	3·2309	3·2297	−0·001	19·292	19·259	+0·03
54	87 Piscium	1	7	3·1709	3·1656	−0·005	19·279	19·251	+0·03
55	88 Piscium	1	8	3·1103	3·1071	−0·003	19·260	19·225	+0·04
56	39 Ceti	1	10	3·0475	3·0386	−0·009	19·208	19·138	+0·07
57	41 Ceti	1	11	3·0113	3·0101	−0·001	19·176	19·117	+0·06
58	Bradley 166	1	12	4·8594	4·8585	−0·001			
59	35 Cassiopeiæ, 2nd star	1	12	3·8687	3·8758	+0·007	19·166	19·130	+0·04*
60	*l* Piscium	1	14	3·2847	3·2858	+0·001	19·111	19·020	+0·09
61	43 Ceti	1	16	3·0605	3·0578	−0·003	19·052	19·038	+0·01
62	47 Andromedæ	1	16	3·3833	3·3887	+0·005	19·052	19·030	+0·02

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63	92 Piscium	I	17	3·1989	3·2009	+0·002	19·030	18·968	+0·06
64	46 Ceti	I	19	2·9492	2·9489	0·000	18·956	18·957	0·00
65	Bradley 191	I	19	3·0603	3·0599	0·000*			
66	47 Ceti	I	20	2·9601	2·9594	−0·001	18·923	18·909	+0·01
67	95 Piscium	I	21	3·1050	3·1004	−0·005	18·914	18·762	+0·15
68	97 Piscium	I	23	3·2136	3·2152	+0·002			
69	48 Ceti	I	23	2·8794	2·8809	+0·002			
70	Bradley 204	I	25	3·2048	3·2107	+0·006*			
71	Bradley 195	I	26	5·8213	5·8126	−0·009*			
72	100 Piscium	I	28	3·1702	3·1670	−0·003	18·702	18·687	+0·02
73	49 Ceti	I	28	2·9256	2·9282	+0·003	18·684	18·672	+0·01
74	50 Ceti	I	29	2·9259	2·9254	−0·001	18·640	18·641	0·00
75	χ Andromedæ	I	31	3·5453	3·5418	−0·004*	18·597	18·591	+0·01
76	42 Cassiopeiæ	I	32	4·4304	4·4382	+0·008	18·580	18·574	+0·01
77	Bradley 225	I	34	3·3588	3·3565	−0·002	18·499	18·470	+0·03
78	Bradley 236	I	41	3·2309	3·2261	−0·005			
79	Bradley 240	I	44	3·7635	3·7610	−0·003*			
80	55 Andromedæ	I	45	3·5506	3·5471	−0·004	18·104	18·087	+0·02
Q 81	7 Arietis	I	48	3·3183	3·3161	−0·002	17·979	17·970	+0·01
Q 82	47 Cassiopeiæ	I	52	5·5428	5·5676	+0·025*	17·928	17·874	+0·05
83	49 Cassiopeiæ	I	53	5·3672	5·3545	−0·013*	17·874	17·887	−0·01
84	52 Cassiopeiæ	I	53	+4·3253	+4·3230	−0·002	−17·833	−17·815	+0·02

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No.	Name of Star.	Approx. R.A. 1864. h	m	Mean Precession in R.A. s	Mean Annual Motion. s	Proper Motion in R.A. s	Mean Precession in N.P.D. ″	Mean Annual Motion. ″	Proper Motion in N.P.D. ″
85	57 Ceti	1	53	+2·8229	+2·8212	−0·002	−17·759	−17·749	+0·01
86	51 Cassiopeiæ	1	54	5·1640	5·1490	−0·015*	17·825	17·793	+0·03*
87	10 Arietis	1	56	3·3662	3·3757	+0·010	17.673	17·679	−0·01
88	60 Ceti	1	56	3·0622	3·0657	+0·004	17·650	17·662	−0·01
89	Bradley 279	1	57	3·3679	3·3675	0·000*			
90	61 Ceti	1	57	3·0570	3·0598	+0·003	17·624	17·545	+0·08
91	Bradley 284	1	59	3·3724	3·3714	−0·001*			
92	11 Arietis	1	59	3·3710	3·3674	−0·004	17·537	17·506	+0·03
93	58 Andromedæ	2	0	3·5633	3·5734	+0·010	17·495	17·435	+0·06
94	14 Arietis	2	2	3·3801	3·3839	+0·004	17·429	17·383	+0·05
95	62 Ceti	2	2	3·0334	3·0272	−0·006	17·391	17·362	+0·03
96	59 Andromedæ	2	3	3·5937	3·5909	−0·003	17·397	17·370	+0·03
97	Bradley 294	2	3	3·5937	3·5910	−0·003			
98	5 Trianguli	2	3	3·4681	3·4700	+0·002*	17·354	17·330	+0·02*
99	*b* Andromedæ	2	5	3·7090	3·7023	−0·007	17·309	17·281	+0·03
100	63 Ceti	2	5	3·0388	3·0384	0·000*	17·285	17·230	+0·06
101	66 Ceti	2	6	3·0318	3·0598	+0·028	17·231	17·165	+0·07
102	Bradley 309	2	6	3·3035	3·3035	0·000			
103	20 Arietis	2	8	3·3929	3·4043	+0·011	17·152	17·076	+0·08
104	21 Arietis	2	8	3·3820	3·3748	−0·007	17·151	17·058	+0·09

105	8 Persei	2	8	4·1383	4·1388	+0·001*	17·158	17·148	+0·01
106	γ Trianguli	2	9	3·5246	3·5282	+0·004	17·097	17·057	+0·04
107	23 Arietis	2	12	3·3135	3·3106	−0·003	16·982	16·859	+0·12
108	Bradley 325	2	12	3·8186	3·8195	+0·001	16·985	16·978	+0·01
109	63 Andromedæ	2	12	3·8975	3·8966	−0·001	16·985	16·952	+0·03
110	70 Ceti	2	15	3·0487	3·0454	−0·003	16·796	16·727	+0·07
111	64 Andromedæ	2	15	3·9129	3·9127	0·000	16·824	16·779	+0·05
112	10 Persei	2	16	4·1409	4·1388	−0·002	16·820	16·828	−0·01
113	Bradley 336	2	17	3·1934	3·1890	−0·004*			
114	71 Ceti	2	18	3·0236	3·0238	0·000	16·657	16·673	−0·02
115	66 Andromedæ	2	19	3·9492	3·9500	+0·001	16·665	16·557	+0·11
116	ρ Ceti	2	19	2·8954	2·8930	−0·002	16·589	16·572	+0·02
117	11 Trianguli	2	19	3·5203	3·5177	−0·003	16·614	16·582	+0·03
118	25 Arietis	2	20	3·1952	3·1746	−0·021	16·564	16·344	+0·22
119	13 Trianguli	2	21	3·4915	3·4846	−0·007	16·543	16·595	−0·05
120	26 Arietis	2	23	3·3353	3·3379	+0·003	16·431	16·396	+0·04
121	σ Ceti	2	26	3·8457	3·8395	−0·006	16·273	16·175	+0·10
122	Bradley 355	2	26	3·3255	3·3292	+0·004	16·277	16·292	−0·02*
123	77 Ceti	2	28	2·9498	2·9527	+0·003	16·157	16·066	+0·09
124	80 Ceti	2	29	2·9493	2·9408	−0·009	16·089	16·019	+0·07
125	Bradley 358	2	31	+4·9705	+4·9980	+0·028*	−16·109	−16·089	+0·02

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126	81 Ceti	2	31	+3·0116	+3·0140	+0·002	−16·010	−15·971	+0·04
127	11 Persei	2	33	4·2012	4·2061	+0·005	15·932	15·913	+0·02
128	84 Ceti	2	34	3·0495	3·0533	+0·004*	15·833	15·700	+0·13
129	Bradley 379	2	35	3·2121	3·2106	−0·002*			
130	Bradley 391	2	41	3·4562	3·4600	+0·004	15·490	15·480	+0·01
131	Bradley 403	2	45	3·1578	3·1589	+0·001*			
132	ρ^1 Arietis	2	47	3·3390	3·3402	+0·001	15·122	15·100	+0·02
133	Bradley 396	2	51	8·4248	8·3936	−0·031*	15·171	15·173	0·00
134	Bradley 416	2	53	3·7105	3·7141	+0·004*	14·820	14·780	+0·04*
135	50 Arietis	2	53	3·3513	3·3479	−0·003			
136	7 Eridani	2	54	3·0133	3·0116	−0·002*	14·711	14·732	−0·02
137	ρ^1 Eridani	2	54	2·9362	2·9411	+0·005	14·677	14·588	+0·09
138	93 Ceti	2	55	3·1286	3·1233	−0·005	14·642	14·639	0·00
139	ρ^2 Eridani	2	56	2·9345	2·9342	0·000	14·586	14·571	+0·02
140	52 Arietis	2	57	3·4914	3·4884	−0·003	14·530	14·506	+0·02
141	54 Arietis	3	1	3·3761	3·3756	−0·001	14·331	14·346	−0·02
142	Bradley 444	3	2	3·5340	3·5335	−0·001*			

No. 142. The R.A. of the *Fundamenta* has been increased 1′.

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143	59 Arietis	3	12	3·5573	3·5538	−0·004	13·639	13·549	+0·09
144	κ^1 Ceti	3	12	3·1169	3·1331	+0·016	13·587	13·605	−0·02
145	*l* Persei	3	12	3·9745	3·9676	−0·007	13·626	13·607	+0·02
146	60 Arietis	3	12	3·5288	3·5288	0·000	13·600	13·496	+0·10
147	62 Arietis	3	14	3·5734	3·5738	0·000	13·497	13·457	+0·04
148	Bradley 475	3	17	3·4619	3·4663	+0·004*			
149	Bradley 480	3	21	4·1757	4·1800	+0·004	13·072	13·021	+0·05
150	Bradley 483	3	23	4·1790	4·1787	0·000			
151	36 Persei	3	23	4·1077	4·1030	−0·005	12·932	12·849	+0·08
152	Bradley 490	3	27	3·7030	3·7047	+0·002			
153	Bradley 492	3	27	3·6963	3·6921	−0·004			
154	Bradley 496	3	30	3·0704	3·0739	+0·004	12·413	12·232	+0·18
155	21 Eridani	3	32	2·9551	2·9500	−0·005	12·234	12·004	+0·23
156	*o* Persei	3	34	3·7703	3·7700	0·000	12·181	12·164	+0·02
157	22 Eridani	3	34	2·9623	2·9601	−0·002	12·124	12·115	+0·01
158	24 Eridani	3	37	3·0377	3·0343	−0·003	11·867	11·853	+0·01
159	21 Tauri	3	38	3·5492	3·5509	+0·002	11·892	11·839	+0·05
160	22 Tauri	3	38	3·5490	3·5490	0·000	11·882	11·820	+0·06*
161	u^1 Tauri	3	38	3·1741	3·1744	0·000*	11·816	11·788	+0·03
162	π Eridani	3	40	2·8262	2·8256	−0·001*	11·705	11·752	−0·05
163	Bradley 522	3	40	+3·5281	+3·5272	−0·001	−11·709	−11·648	+0·06

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164	Bradley 523	3	40	+3·5491	+3·5496	+0·001*			
165	26 Tauri	3	41	3·5388	3·5379	−0·001			
166	n Persei	3	41	3·7639	3·7604	−0·004	−11·669	−11·670	0·00
167	u^2 Tauri	3	45	3·1859	3·1833	−0·003	11·369	11·346	+0·02
168	29 Eridani	3	46	2·9620	2·9597	−0·002			
169	30 Eridani	3	46	2·9560	2·9544	−0·002	11·264	11·241	+0·02
170	A Persei	3	47	4·3932	4·4011	+0·008	11·316	11·177	+0·14
171	τ^8 Eridani	3	48	2·5472	2·5490	+0·002	11·096	11·076	+0·02
172	Bradley 545	3	53	3·5414	3·5417	0·000	10·798	10·744	+0·05
173	τ^9 Eridani	3	54	2·5529	2·5528	0·000	10·641	10·646	−0·01
174	40 Tauri	3	57	3·1687	3·1658	−0·003	10·504	10·476	+0·03
175	49 Persei	3	59	3·9412	3·9321	−0·009	10·348	10·186	+0·16
176	50 Persei	3	59	+3·9515	+3·9660	+0·014	−10·328	−10·129	+0·20